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Fixation time, smiling, vocalization, and fret/cry were recorded to obtain a complete picture of infants' responses to facial stimuli over the first year of life. Four stimuli were presented to 120 infants. Results of fixation data indicate that (1) there is a marked decrease in fixation toward facial stimuli within the first year, (2) at all ages boys look longer than girls, and (3) in the first half year realistic stimuli were preferred, and in the second half year nonrealistic stimuli were preferred. The results of smiling and vocalization were parallel: (1) both increased over the first year, (2) girls smiled and vocalized more than boys, (3) realistic facial patterns elicited more smiling and vocalization regardless of age. Fret/cry data were included to determine if stimuli would elicit consistent fear or unpleasant responses. Results indicate (1) a decrease in fret/cry over age, (2) that boys show more fret/cry than girls, and (3) that stimuli fail to elicit consistent or observable fear responses. The difference between the measures suggests that the responses are under the service of two systems, one affected by familiarity and novelty; the other, by innate releasing mechanisms or social learning. (DO)

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Infants' Responses to Facial Stimuli During the First Year of Life: Exploratory Studies in the Development of a Face Schema[1]

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Abstract

Four different facial stimuli were presented to approximately 120 infants within the first year of life in order to observe any developmental changes in interest in faces. Four measures were taken: fixation time, smiling, vocalization and fret/cry. The fixation data, especially for girls, varied over the first year, with realistic stimuli eliciting more looking in the first half year and distortions eliciting more looking in the second half year. Stimulus differences in smiling and vocalization remained invariant over age and indicated that realistic faces elicited more smiling and vocalization than distorted faces. The difference between these measures and fixation suggest that the responses are under the service of two different systems, one affected by familiarity and novelty and the other by such processes as innate releasing mechanisms or social learning.

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Infants' Responses to Facial Stimuli During the First Year of Life: Exploratory Studies in the Development of a Face Schema

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Research on the response to human faces proceeds from a variety of experimental objectives. There are those investigators who are interested in the infant's response to the face as a measure of social interaction (Gerwitz, 1965; Ambrose, 1961). Others wish to determine what aspects of the face are attractive to the infant and how much of the facial pattern need be present to elicit responses such as smiling or attention (Spitz & Wolf, 1946; Watson, 1966). Still another interest in human faces deals with the general exploration of schema development using the face as a developing schemata.

A schema may be defined as a relatively persistent organized classification of information, a model which the organism utilizes in arranging information. At any given point in his development, an infant has schemata at different points of development which with time will codify and then alter toward or be rejected for new schemata. When the input from the environment or experiment matches a recently or nearly formed schema, the infant will spend long periods

looking at that input. After the schema is well developed, the infant will lose interest in stimuli which match it. Thus, if a stimulus array partially violates an existing schema, the violation will elicit attention. However, if the violation is so radical that the infant cannot perceive his schema within it, he will not spend time looking at the stimulus. We (Lewis, Bartels & Fadel, 1966) have called those stimuli which match the schema "familiar," and those which do not, "novel."

Kagan and Lewis (1965) using 6-month-old infants showed that photographs of faces elicited more fixation than face-like stimuli such as the face of a panda bear; while Lewis, Kagan and Kalafat (1966) showed that a photograph of a male face when presented to 6-month-old infants elicited more fixation than a line drawing of a face. However, when these stimuli were shown to the same Ss at 13 months, the line drawing elicited more fixation than did the photograph.

Investigation of developmental changes in response to facial stimuli over the first year is rare. Most of the existing studies are concerned only with the development of the smiling response. Moreover, the work on the smiling response and its change over age has dealt primarily with live human faces, either male or female, and not with pictures of faces or face-like stimuli. The purpose of the present study, therefore, was to investigate the developmental trends in the interest value of faces and face-like stimuli and relate any changes to schema acquisition.

Recently, Kagan, Henker, Hen-Tov, Levine and Lewis (1966) showed that for 4-month-old infants, more than one response measure was needed to demonstrate stimulus differentiation. Moreover, Lewis, et al. (1966) and Lewis (1967) suggested that fixation time and such behavior as smiling and autonomic change reflect differential aspects of an attentive response. Fixation time, smiling, vocalization and fret/cry were recorded in order to obtain a more complete picture of infants' response to facial stimuli over the first year of life.

Working from the notion of schema development (Lewis, et al. 1966; Lewis, Goldberg & Rausch, 1967), it was hypothesized that the attentional value of facial stimuli would change over the first year, the more realistic faces eliciting more interest in the earlier months before complete schema acquisition and distortions eliciting interest in the latter months after the schema is well developed. This change in attentional value would be reflected in fixation changes.

Smiling and vocalization should also be affected by these stimulus x age interactions. However, this interaction is unclear. Kagan, et al. (1966) would predict that stimuli which match emerging schema would elicit smiling and vocalizing, and Lewis, Goldberg and Rausch (1967) have demonstrated that smiling was produced by violating children's expectations. However, Spitz's (1946) work would lead one to believe that realistic stimuli will elicit more smiling as would Gewirtz's (1965) work on secondary reinforcement and smiling. Thus, smiling can serve multiple needs or motives.

Method

Subjects

In order to observe age differences in response to facial stimuli, we studied children from four different age groups. To avoid the effects of repeated presentation, a cross-sectional design was used. Fifteen boys and 15 girls were seen at each of four age levels: 12 weeks of age (± 4 days), 24 weeks of age (± 7 days), 36 weeks of age (± 7 days), and 57 weeks of age (± 9 days).

Apparatus

The seating arrangement varied for each age group. The youngest Ss were placed in a slightly reclining chair, while the oldest Ss sat in a baby-feeder or high chair. The mother sat to the side and rear of S. Both infant and mother were completely enclosed and, except for several observation windows, were surrounded by a uniform grey area. Immediately in front of S and approximately 18 inches from his head was a grey screen on which the stimuli were presented by rear-screen projection.

Procedure

After S was placed in the appropriate position, four different face stimuli were presented to each S. The stimuli, presented in Figure 1, were: (1) regular face--a photograph of a male; (2) cyclops face--a photograph of a one-eyed face; (3) schematic face--a line drawing of a face with all the features in their normal positions; and

(4) scrambled face--a line drawing with all the features misplaced. Each of the four stimuli was presented three times in random order for 12 seconds. There was a 12-second inter-trial interval during which the screen was relatively dark. The order of presentation was as follows: schematic, scrambled, cyclops, regular, schematic, regular, scrambled, cyclops, scrambled, cyclops, schematic, regular. If S became sleepy or upset during the presentation, the episode was terminated and was resumed when S was again in an alert state.

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Figure 1 about here
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Measures

Four measures were taken. Fixation time was recorded by two independent observers who were unaware of the stimulus being presented. The observers were hidden behind the enclosure and were not visible to the infant. The first time S oriented his head and eyes toward the array, the observers depressed a key marking the duration of that fixation on an event recorder. The inter-scorer reliability for FF was .90.

Smiling, vocalizing and fret/cry were also recorded independently on an event recorder by two observers, regardless of whether S was oriented toward the array. These observers were also hidden behind the screens. For the purpose of this paper, only those behaviors

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emitted during or immediately after a fixation will be used in the analysis. It was found that for smile, vocalization and fret/cry, approximately 93 per cent of these behaviors occurred during fixation, two per cent were emitted after and five per cent prior to fixation. The five per cent emitted prior to fixation were not included, since it was not possible to determine what elicited the particular behavior. The interscorer reliability for these measures was .93 for smiling, .87 for vocalization, and .84 for fret/cry.

Fixation Data

Figure 2 presents the FF data for each age group and for each stimulus. Observation of the data indicate several important effects: (1) amount of fixation time changes, (2) sex differences, and (3) stimulus differences.

1. Amount of Fixation Time

The fixation time data indicate a decrease in looking for both sexes over age ($\bar{x}$ FF 3M = 6.38; 6M = 5.18, 9M = 4.42, 13M = 4.41). A Kruskal-Wallis test was performed for each stimulus with sex combined and the results indicate significant age effects ($p<.05^2$ for each stimulus).

2. Sex Differences

Boys looked longer than girls at all four facial patterns. Combining stimuli this difference was significant for 3- and 6-month-olds

(Mann-Whitney U test, U = 59, p<.05; U = 54, p<.02 respectively), but failed to reach significance for 9- and 13-month-olds. While girls tended to show greater stimulus differentiation, this was clearly seen only at three months of age when girls showed significant differentiation and boys did not.

3. Stimulus Differences

A Friedman two-way analysis of variance (Siegel, 1956) was performed for each age separately. The results indicated that at three months, girls showed significant stimulus differentiation (X_r^2 = 10.76, p<.02) and the boys did not, while at six months, both girls and boys showed significant differentiation (X_r^2 = 13.32, X_r^2 = 13.16, p<.01, respectively). The 9- and 13-month data failed to show any significant differentiation for either sex. The results indicated a decrease in differentiation and fixation across age, probably reflecting a loss of preference, at least as measured by fixation time, for this class of stimuli.

For girls at three months, the two photographs (regular and cyclops faces) were looked at longer than the two line drawings (schematic and scrambled faces); Sign test, p<.03. The boys' data paralleled that of the girls but was not significant. At six months, the distortions (cyclops and scrambled faces) were looked at significantly less than the realistic faces (regular and schematic faces); by Sign test, p<.001 for girls, p<.01 for boys.

That there were no significant stimulus differences at nine and 13 months is a function of the relatively low level of response to facial stimuli at these ages. Because of this minimal response, developmental changes in stimulus interest are not obvious. By a simple transformation, the fixation changes may be more easily observable. For each age level and sex, the mean time S fixated on each stimulus was compared to the sum of the fixation time for all four stimuli, and a percentage fixation time score was obtained. Figure 3 presents these percentage scores.

It is clear that there is relatively little percentage change within the first year. Moreover, boys show less change than girls. For girls, the percentage fixation time over age for regular face, the most realistic, indicated a decrease in fixation over the first year, i.e., the percentage of time they spent looking at the array decreased with age. The data for the scrambled face, the least realistic stimulus, indicated just the reverse. A Fisher Exact Probability test analysis was performed using the number of Ss showing greater fixation time for regular face than to scrambled face at three and 13 months. While boys' data were not significant, girls' data (12, 3, 5, 10 distribution) were significant at the $p<.05$ level. Thus, interest in the least realistic face accompanied disinterest in the most realistic face.

The data for the cyclops and schematic faces indicated a curvilinear relation for both sexes. These are the two stimuli which elicit the greatest changes in response with increasing age. Moreover, whatever stimulus qualities these two arrays possess, they seem to produce reverse effects. Cyclops face elicits relatively high fixations at three and 13 months and relatively low fixations at six and nine, while schematic face shows the reverse pattern. To demonstrate the significance of these changes, Fisher Exact Probability tests were employed for the three versus six months and the nine versus 13 months comparisons. For the three-six month comparison the distribution combining sex was 20, 10, 10, 20 (X^2 = 5.40, $p<.05$), while the combined sex nine-13 month comparison was 10, 20, 15, 15, and did not reach significance (X^2 = 1.40). The data indicated that there were age changes for schematic and cyclops faces over the first year; however, the nature of these changes were not as consistent as the scrambled-regular face changes.

To summarize the fixation data, three results appear evident: (1) there is a marked and significant decrease in fixation toward facial stimuli within the first year, (2) at all ages, boys look longer than girls, although girls appear to show somewhat greater stimulus differentiation than do boys, (3) there are age changes in the interest value of these facial stimuli over the first year such that realistic stimuli were preferred in the opening half of the first year and the nonrealistic stimuli were preferred in the second half.

Smiling

The data on smiling are presented in Table 1. The small amounts of time smiling (less than two seconds out of 12) reflect both the short duration of a smile and the few infants who smiled at the stimuli at each age.

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Table 1 about here
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1. Amount of Smiling

Both the number of Ss who smiled as well as the amount of smiling increased as a function of age. Boys' data showed a monotonic increase across all stimuli, while the girls' data also indicated increased smiling across the first year. A chi square analysis tested the number of Ss smiling or not smiling in the first half-year as compared to the second half-year for each stimulus with sex combined. Increased smiling over the first year was apparent for each stimulus. (regular face, $X^2 = 2.86$, $.05<p<.10$; schematic face, $X^2 = 10.03$, $p<.01$; cyclops face, $X^2 = 1.82$; scrambled face, $X^2 = 6.02$, $p<.02$).

2. Sex Differences

While girls tended to smile more than boys, the differences at each age were not significant. Girls did show significant stimulus differentiation at each age while boys did not. In order to test this sex difference in stimulus differentiation, age groups were collapsed and each S's score for the difference between the sum of schematic plus regular faces versus cyclops plus scrambled faces was obtained. Boys'

difference scores were compared to girls' by a Mann-Whitney U test which revealed significant sex differences in smiling, the girls having shown more differentiation than boys ($\underline{Z}$ = 2.59, $\underline{p}$<.01).

3. Stimulus Differences

Boys' smiling data, like their fixation data, failed to show any significant stimulus differences at any age. Girls' data, unlike their fixation data, showed significant stimulus differences throughout the first year (by Friedman two-way analysis of variance: 3M, X_r^2 = 9.38, $\underline{p}$<.05; 6M, X_r^2 = 4.74, $\underline{p}$<.15; 9M, X_r^2 = 8.54, $\underline{p}$<.05; 13M, X_r^2 = 7.92, $\underline{p}$<.05). Thus, while fixation time differences diminished over age, smiling response was constant.

Observation of the data of Table I reveals that schematic and regular faces elicited more smiling than did the cyclops and scrambled faces for each age level. A Friedman two-way analysis of variance with age combined indicated significant stimulus differences for girls (X_r^2 = 31.86, $\underline{p}$<.001), but not for boys (X_r^2 = 5.75). In order to test whether regular and schematic faces were significantly different from cyclops and scrambled faces, a Sign test was performed at each age level and indicated for girls significant differences across age (3M, $\underline{p}$<.004; 6M, $\underline{p}$<.03; 9M, $\underline{p}$<.09; 13M, $\underline{p}$<.03, all two tailed)

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Figure 4 about here
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Finally, Figure 4 presents the percentage of smile to each stimulus as a function of the total amount of time smiling to all four stimuli at each age level. The percentage score was obtained in the same manner as were the fixation percentage scores. The data of Figure 4 indicate that regular and schematic faces elicit more smiling than cyclops and scrambled faces at each age level. Unlike fixation data, stimulus differences as a function of age are invariant and appear to indicate that regardless of fixation changes, smiling, at least in the first year, is elicited by a class of realistic facial patterns, i.e., arrays having all features in their normal positions.

Vocalization

Table 2 presents the vocalization data. As found for the smiling data, there was relatively little vocalization for these stimuli at these age levels.

1. Amount of Vocalization

Both the amount of vocalization and the number of Ss vocalizing indicate increases in vocalization for all stimuli across age. Boys showed a monotonic increase across age which parallels their smiling data. Girls showed an increase for the first nine months which also parallels their smiling data. Using a Mann-Whitney test to compare the amount of vocalization in the first half year with the amount of vocalization in the second half year revealed a significant difference for boys ($Z = 2.25$, $p<.03$) and a trend for girls ($Z = 1.35$, $p<.10$).

2. Sex Differences

The data indicate that girls vocalize more than boys to each stimulus at all ages with the two exceptions of scrambled face at six months and cyclops face at 13 months. Combining age and stimuli results in a significant sex difference (Mann-Whitney U test, $Z = 2.45$, $p<.02$). Combining age, girls also showed significant stimulus differentiation ($X_r^2 = 12.53$, $p<.01$), while boys did not. This finding was consistent with the smiling and fixation data.

3. Stimulus Differences

The data on vocalization showed no stimulus differentiation decreases over age. Girls showed significant vocalization differences between the stimuli when age was combined ($X_r^2 = 12.53$, $p<.01$), while boys failed to show significant differences. Girls' data revealed that regular face elicited more vocalization than the other stimuli at each age level. Combining age, a comparison of regular face to the other three stimuli by the Sign test revealed a significant difference at less than the .01 level. No other differences were significant. Moreover, observation of the percentage change data of Table 2 revealed no age change-stimulus interactions.

Fret/Cry

Fret/cry data were included in the present study in order to determine whether any of the photographic stimuli would elicit consistently fearful or unpleasant responses. Further, since stranger

anxiety should occur somewhere within the second half of the first year, the effect of these four stimuli on this response was of interest. Table 3 presents the fret/cry data which also indicate a low frequency of occurrence.

1. Amount of Fret/Cry

The data, both number of Ss and amount of fret/cry, reveal a decrease in fret/cry over age. A chi square analysis comparing the first half year to the second with sexes combined revealed that this decrease was significant for each stimulus (scrambled face, $X^2 = 5.12$, $p<.05$; schematic face, $X^2 = 4.08$; cyclops face, $X^2 = 7.71$, $p<.01$; regular face, $X^2 = 10.83$, $p<.001$).

2. Sex Differences

While boys generally showed more fret/cry than girls, there were no sex differences for each age or for age combined, nor were there any differences for any of the individual stimuli.

3. Stimulus Differences

A Friedman two-way analysis of variance for either sex failed to show any significant stimulus differences for age combined or for each age group separately. Further, the percentage score transformations also presented in Table 3 failed to show any consistent age-stimulus trends.

Behavioral Correlations

Table 4 presents the rank-order correlations for each of the measures considered for each age level with stimuli combined. A rank

of 1 was given to that S who smiled most, a rank of 1 was given to that S who vocalized most or exhibited the most fret/cry.

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Table 4 about here
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The data reveal that for girls, smiling was positively correlated with vocalization and was significantly correlated for six and 13-month-old Ss. Further, smiling was negatively correlated with fret/cry, this being significant at three months. Finally, while vocalization was positively correlated with fret/cry, the correlation was very low and not significant. The boys' data in general parallel that of the girls and indicate a positive correlation between smiling and vocalization which was significant at nine and 13 months. There were no other consistent relations for the boys.

In summary, for both sexes, smiling and vocalization increased over age while fret/cry decreased. Smiling and vocalization were elicited by regular and schematic faces, arrays which were most realistic. There were no stimulus differences for fret/cry. Girls smiled and vocalized more than boys and showed stimulus differentiation while boys did not.

Discussion

It is safe to assume that schemata in infants are in flux, changing and being redefined as the infant experiences more of the world around him. Moreover, at any given point in his development, an infant has a particularly formed schema which with time will

modify. An external stimulus corresponding to a well-formed schema as well as an external stimulus for which there is no schema will elicit little attention. Those stimuli for which there is a partial schema (i.e., developing schema) or which violate an existing schema will elicit attentive behavior (Piaget, 1954; Berlyne, 1960; Fiske & Maddi, 1961). Applying the present data to this theoretical framework, it might be argued that in the early months, before a face schema is sufficiently formed, regular face, a slight violation of the emerging schema, would elicit more attention than scrambled face, a major violation of the emerging schema. However, once the face schema is well developed, distortions of that schema should elicit more attentive behavior. Indeed, if one discounts the three month data for each of the stimuli, preference for the schematic face, more realistic than the cyclops face, decreases over age, while preference for the cyclops face increases. While alternative explanations are possible, the data clearly indicate age changes over the first year in preference to these face and face-like stimuli.

The smiling response data using these four photographs revealed several important results. Girls' data indicate that smiling decreased at six months and reached a peak at nine months. The smiling data for boys indicate, in general, a monotonic increase as a function of age, with no trough at six months. The data for girls' response to a photograph of a male face generally agree with Gewirtz's data (1965)

on home-reared children's response to a live human female face. Both sets of data indicate a trough at six months of age and maximum smiling at three months and at the 9-13 month level. Watson (1966), using both live male and female faces also found that there was a peak at around three months and a trough at six months. Thus, it is clear that both photographs (at least of a male face) and live faces elicit greater smiling at three than at six months. Boys' failure to show any trough at six months and to show a monotonic increase in smiling over the first year does not agree with Gewirtz's findings. However, Laroche and Tcheng (1963) also found no trough at six months and a monotonic increase at least for the first nine months. The data from the present work using photographs instead of live faces result in no greater differences than are found between investigations using live faces.

It is interesting to note that while realistic faces (schematic and regular) elicited more smiling than the distorted faces (cyclops and scrambled), all face and face-like stimuli elicited increases in smiling, and that for the girls, each stimulus showed a trough at six months and peaks at three and nine months. Smiling to pictures over the first year is not limited to realistic patterns of faces. Infants up to a year of age will smile to any pattern which resembles or contains some features of a face. Thus, while faces elicit more smiling than non-faces, responses to face-like stimuli seem to follow

similar developmental patterns. Although this may be the case, the frequency of smiling is a function of the nature of the stimulus presented. Distorted faces elicit less smiling than non-distorted ones and this relation remains invariant over the first year.

The vocalization data are in some ways similar to the smiling data as reflected in the relatively high correlations between the two measures. Both sexes vocalized increasingly as a function of age and vocalized significantly more to the regular face than to the others.

Recent data indicate that faces elicit more vocalization and smiling than nonfaces (Lewis, et al., 1963; Kagan & Lewis, 1965) and that a realistic face elicits more vocalization and smiling than relatively less realistic ones. There are several possible explanations for this finding: (1) faces may act as an innate releasing mechanism for the smiling response (Tinbergen, 1951), especially in the opening / months of life; (2) smiling is a learned response associated through secondary reinforcement with faces (Gewirtz, 1965); (3) smiling is related to an "aha" reaction in the assimilation of partially novel stimuli.

It is clear that smiling and vocalizing can serve any number of needs or motives, and it would be difficult to specify that these responses are elicited for one reason exclusively. However, since smiling and vocalizing have been experimentally elicited only by

facial stimuli, it is not possible to state as Kagan, et al. have, that smiling results from the assimilation of partially novel stimuli alone until smiling to novel stimuli other than faces has been demonstrated. Work with socially deprived and non-socially deprived infants indicates that, at least for the first eight to 12 weeks, smiling and vocalization are relatively independent of the environment (Gewirtz, 1965; Provence, 1965; Lenneberg, Rebelsky & Nichols, 1965). This finding lends support to a notion of initial innate releasers for these responses, after which environmental reinforcers become increasingly important.

One of the chief reasons for observing fret/cry behavior was to determine the effect of stranger anxiety on the infant's response to these four stimuli. A decrease in the frequency of fret/cry over age and no stimulus differences at any age were indicated. Thus, the present data could find no evidence of a fear response. Morgan and Ricciuti (1965) recently reported that fearful responses are elicited not so much by the presence of strangers as by their approach to the infant. Whenever a live face is presented, the presentation (moving over the infant) might constitute an approach, whereas the appearance of a picture at a certain locus might not. Moreover, S might be able to discriminate between a living person and a two-dimensional picture or inanimate object. In any event, the four stimuli failed to elicit any consistent or observable fear responses. However,

observation of many of the Ss in the present study indicates that the approach of a strange experimenter did elicit an anxiety response even though the stimuli themselves were unable to do so.

Girls generally showed greater differentiation among the stimuli not only in terms of their fixation data, but also in terms of their behavioral data. This sex difference has now been seen in several samples for various types of visual and auditory stimuli (Kagan & Lewis, 1965; Lewis, et al., 1966) as well as tactile stimuli (Bell, 1964), and strongly suggest important and early differences in response to stimulation. One implication of these differences is that girls may be better able to differentiate stimuli in their environment. If this is the case, later sex differences in the development of such behavior as language are more easily understood. That is, if girl infants are better able to differentiate sounds at earlier ages, their acquisition of language should also occur earlier. While all the longitudinal data is not yet gathered, we are finding increasing evidence that infants who show early auditory differentiation tend to show earlier language acquisition.

In summary, the fixation data, especially for girls, varied over the first year, with realistic stimuli associated with emergent schema being preferred during the first half year and distortions of the developed schema being preferred in the second half year of life. However, smiling and vocalization remained invariant and indicated

that the realistic faces elicited significantly more smiling and vocalization than the distorted faces. The difference between the measures suggests that the responses are under the service of at least two different systems, one presumably affected by schema development and the other by some invariant process such as an innate releasing mechanism or social learning.

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2. The probability statements for the Kruskal-Wallis one-way analysis of variance and the Friedman two-way analysis of variance are both two-tailed.

Table I

Mean Time Smiling in Seconds by Stimulus, Age and Sex

	Schematic		Scrambled		Cyclops		Regular		Total
	#[a]	$\bar{x}$[b]	#	$\bar{x}$	#	$\bar{x}$	#	$\bar{x}$	$\bar{x}$
3 Months									
Boys	4	0.30	3	0.07	2	0.06	3	0.21	0.16
Girls	5	0.67	3	0.60	3	0.20	7	1.38	0.71
6 Months									
Boys	3	0.46	2	0.05	1	0.02	4	0.47	0.25
Girls	3	0.21	2	0.06	3	0.20	4	0.42	0.22
9 Months									
Boys	8	0.64	6	0.26	5	0.18	5	0.78	0.47
Girls	9	2.08	5	0.82	6	0.62	9	1.94	1.36
13 Months									
Boys	8	1.00	6	1.02	8	0.63	8	1.51	1.04
Girls	8	1.29	6	0.73	6	0.42	6	1.43	0.97

a = Number of subjects who showed smiling regardless of the length of time of the smile.

b.= Mean amount of smiling for all the subjects whether they smiled or not.

Table 2

Mean Time Vocalizing in Seconds by Stimulus, Age and Sex

	Schematic			Scrambled			Cyclops			Regular			Total
	#[a]	$\bar{x}$[b]	%[c]	#	$\bar{x}$	%	#	$\bar{x}$	%	#	$\bar{x}$	%	$\bar{x}$
3 Months													
Boys	7	0.48	(20)	8	0.66	(27)	12	0.67	(27)	9	0.64	(26)	0.61
Girls	6	0.88	(21)	8	0.77	(19)	9	1.01	(25)	10	1.43	(35)	1.02
6 Months													
Boys	4	0.38	(13)	8	1.04	(35)	7	0.79	(26)	8	0.78	(26)	0.75
Girls	9	1.18	(23)	7	0.97	(19)	8	1.40	(27)	11	1.56	(31)	1.28
9 Months													
Boys	10	0.78	(24)	9	0.83	(26)	10	0.80	(25)	9	0.78	(25)	0.80
Girls	13	2.03	(22)	12	2.34	(26)	14	2.05	(23)	14	2.60	(29)	2.26
13 Months													
Boys	8	0.97	(18)	10	1.14	(22)	13	1.46	(28)	11	1.65	(32)	1.31
Girls	7	1.15	(21)	7	1.28	(24)	7	0.74	(14)	10	2.25	(41)	1.36

a = Number of subjects who showed vocalizing regardless of the length of time of the vocalization.

b = Mean amount of vocalizing for all the subjects whether they vocalized or not.

c = Percentage of vocalization to particular stimulus as a function of total amount of vocalization to all stimuli $\frac{S_1}{\Sigma\ S_1 + S_2 + S_3 + S_4}$

Table 3

Mean Time Fret/Cry in Seconds by Stimulus, Age and Sex

	Schematic			Scrambled			Cyclops			Regular			Total
	#[a]	$\bar{x}$[b]	%[c]	#	$\bar{x}$	%	#	$\bar{x}$	%	#	$\bar{x}$	%	$\bar{x}$
3 Months													
Boys	11	0.71	(11)	11	1.89	(29)	11	1.91	(29)	12	2.00	(31)	1.63
Girls	9	0.63	(22)	8	0.37	(13)	9	0.91	(32)	9	0.94	(33)	0.71
6 Months													
Boys	5	0.77	(27)	4	0.51	(17)	5	0.71	(24)	8	0.95	(32)	0.74
Girls	8	0.28	(19)	6	0.19	(13)	8	0.63	(43)	9	0.37	(25)	0.37
9 Months													
Boys	6	0.24	(14)	4	0.41	(25)	6	0.71	(43)	8	0.30	(18)	0.42
Girls	8	0.47	(30)	7	0.53	(35)	4	0.03	(2)	5	0.51	(33)	0.38
13 Months													
Boys	3	0.04	(11)	3	0.14	(22)	4	0.14	(36)	2	0.11	(31)	0.10
Girls	4	0.00	(0)	2	0.00	(0)	2	0.03	(27)	4	0.09	(73)	0.03

a = Number of subjects who showed fret/cry regardless of the length of time of the fret/cry.

b = Mean amount of fret/cry for all the subjects whether they fretted/cried or not.

c = Percentage of fret/cry to particular stimulus as a function of total amount of fret/cry to all stimuli. $\frac{S_1}{\Sigma S_1 + S_2 + S_3 + S_4}$

Table 4

Behavioral Correlations with Stimuli Combined for Each Age and Sex

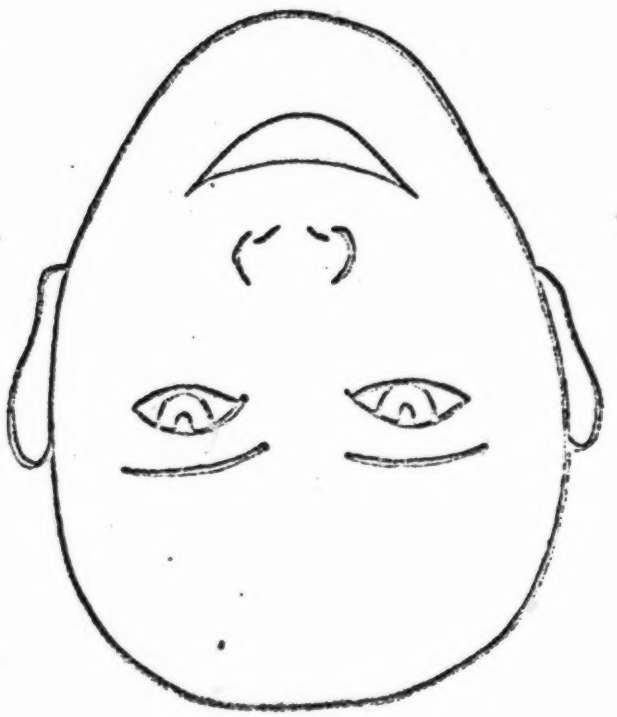
	Smile	Voc	F/C
		3 Months	
Smile	----	.22	-.53*
Voc	.07	----	.15
Fret/Cry	-.16	-.21	----
		6 Months	
Smile	----	.48*	-.40
Voc	.17	----	.25
Fret/Cry	.33	.36	----
		9 Months	
Smile	----	.12	-.06
Voc	.50*	----	.13
Fret/Cry	-.11	.21	----
		13 Months	
Smile	----	.64**	-.10
Voc	.62**	----	.14
Fret/Cry	.23	-.13	----

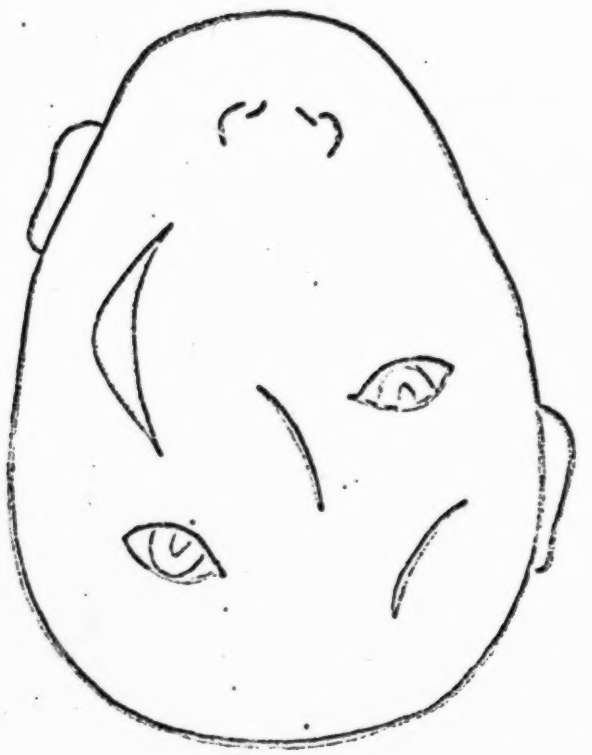
Boys' data to the bottom and left
Girls' data to the top and right

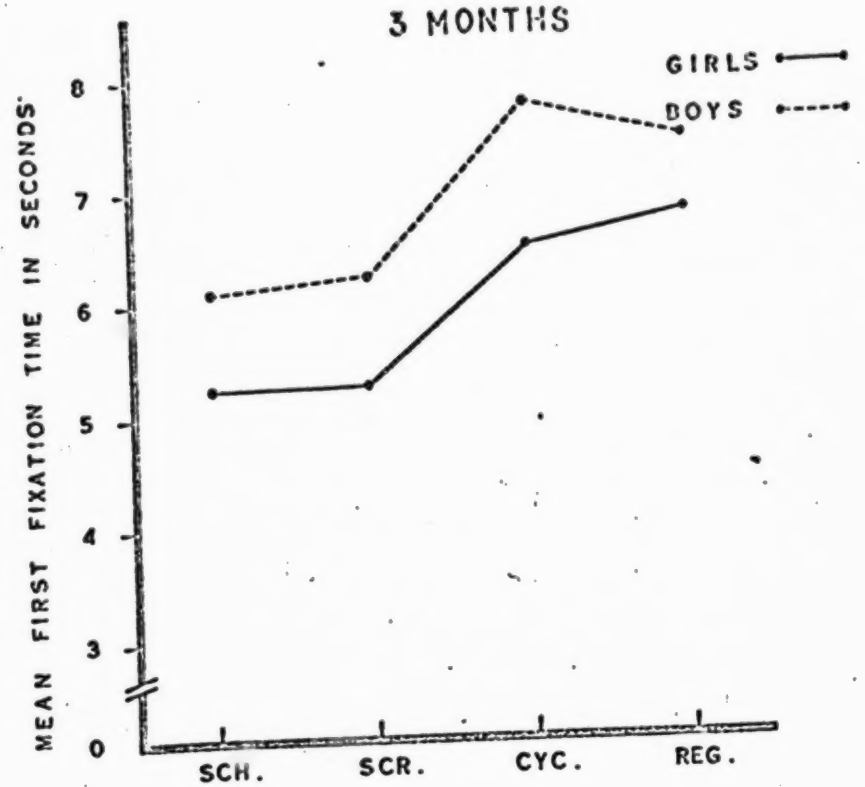
*$p<.05$, 1 Tail
**$p<.01$, 1 Tail

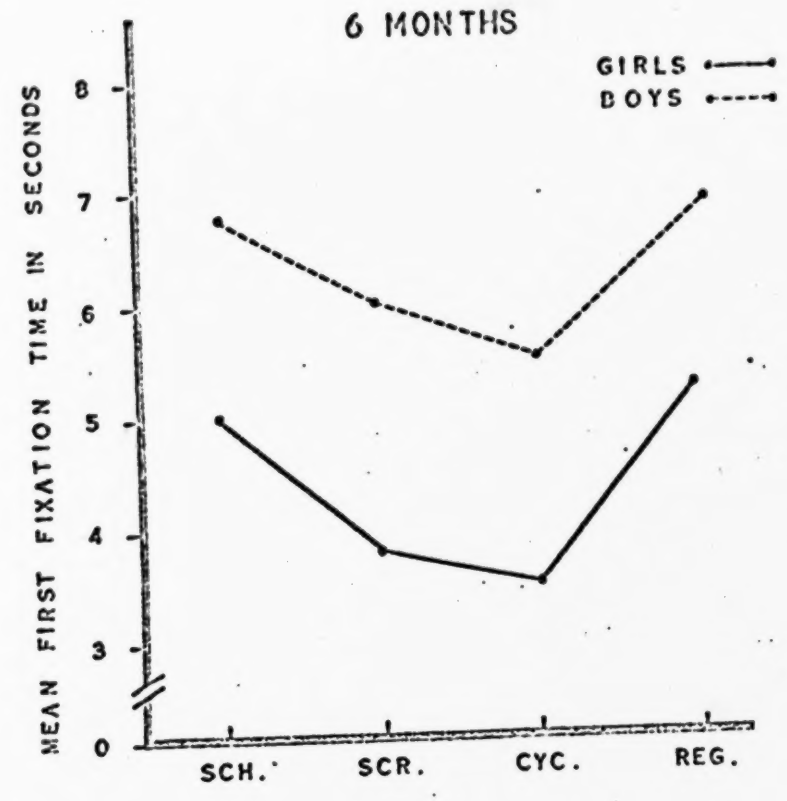
Figure Captions

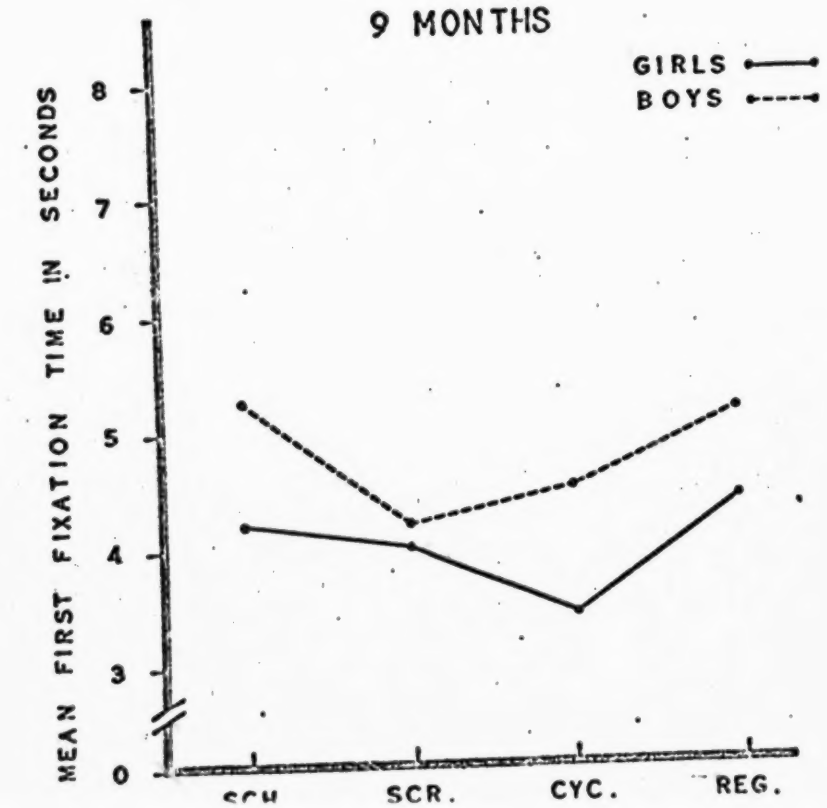
1. Four facial arrays used as stimuli. Top left--scrambled face; top right--cyclops face; bottom left--schematic face; bottom right--regular face.
2. Mean first fixation time as a function of stimulus and sex for each age level.
3. Mean per cent of time fixated as a function of stimulus, age and sex.
4. Mean per cent of time smiling as a function of stimulus, age and sex.

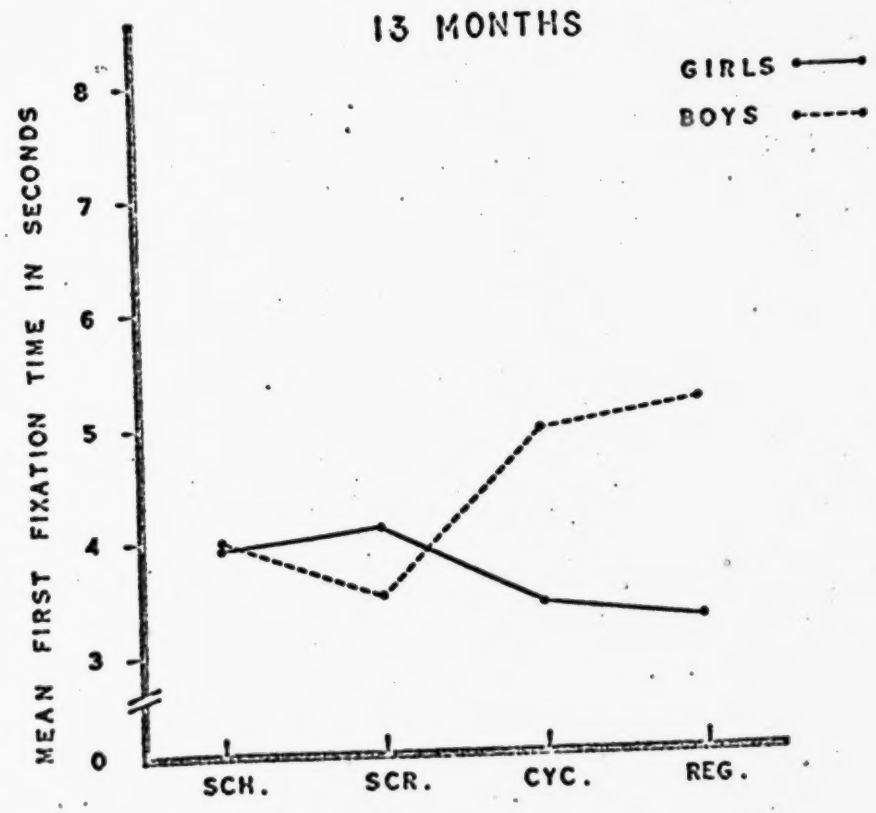


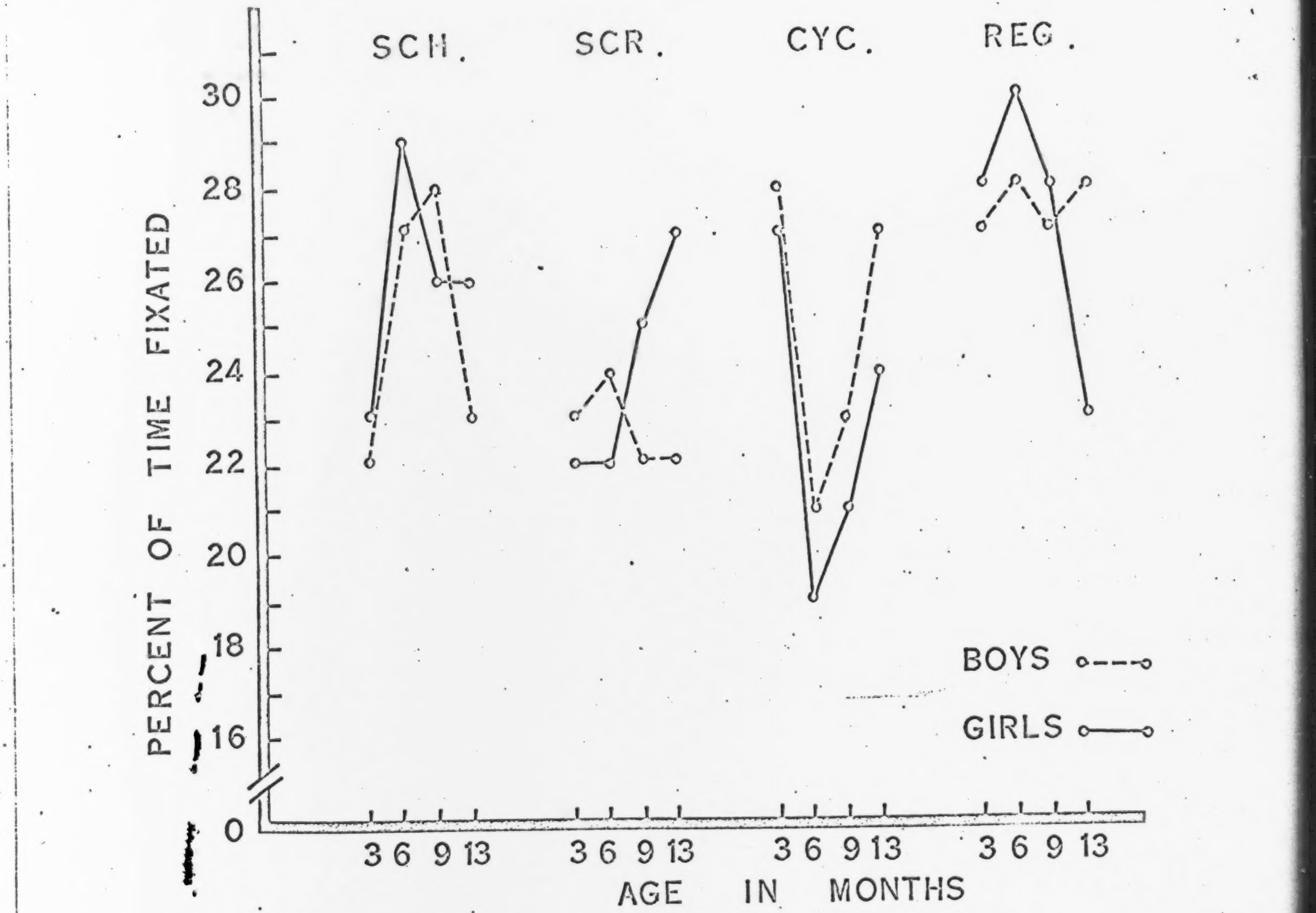


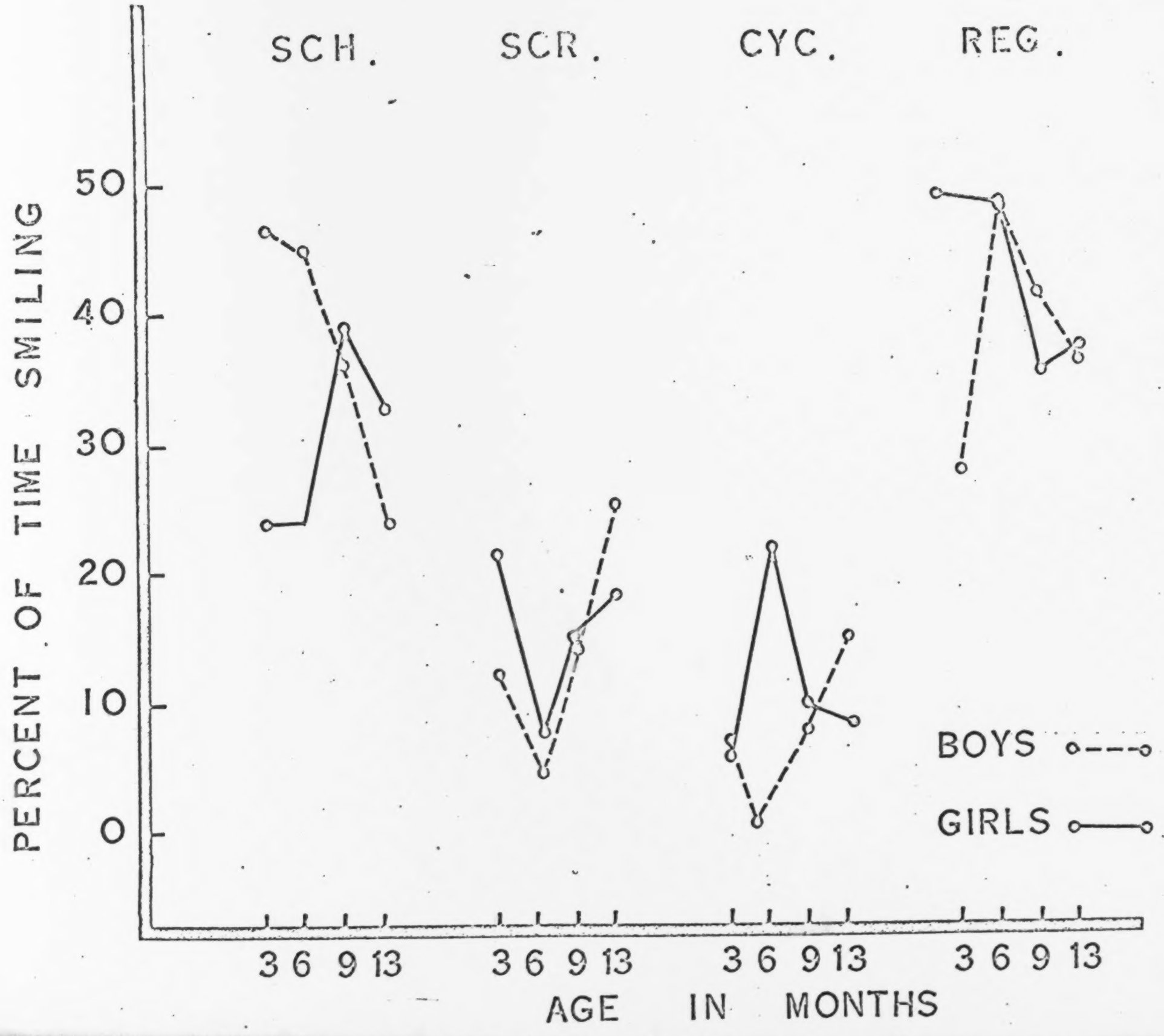

3 MONTHS
GIRLS
BOYS
MEAN FIRST FIXATION TIME IN SECONDS
0
3
4
5
6
7
8
SCH.
SCR.
CYC.
REG.


6 MONTHS
GIRLS
BOYS
MEAN FIRST FIXATION TIME IN SECONDS
0
3
4
5
6
7
8
SCH.
SCR.
CYC.
REG.


9 MONTHS
GIRLS
BOYS
MEAN FIRST FIXATION TIME IN SECONDS
0
3
4
5
6
7
8
SCH.
SCR.
CYC.
REG.


13 MONTHS
GIRLS
BOYS
MEAN FIRST FIXATION TIME IN SECONDS
0
3
4
5
6
7
8
SCH.
SCR.
CYC.
REG.


SCH.
SCR.
CYC.
REG.
PERCENT OF TIME FIXATED
30
28
26
24
22
20
18
16
0
3 6 9 13
3 6 9 13
3 6 9 13
3 6 9 13
AGE IN MONTHS
BOYS
GIRLS


SCH.
SCR.
CYC.
REG.
PERCENT OF TIME SMILING
50
40
30
20
10
0
3 6 9 13
3 6 9 13
3 6 9 13
3 6 9 13
AGE IN MONTHS
BOYS
GIRLS